

Model Railway Short-Circuit Beeper

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Short circuits in the tracks, points or wiring are almost inevitable when building or operating a model railway. Although transformers for model systems must be protected against short circuits by built-in bimetallic switches, the response time of such switches is so long that it is not possible to immediately localise a short that occurs while the trains are running, for example. Furthermore, bimetallic protection switches do not always work properly when the voltage applied to the track circuit is relatively low.

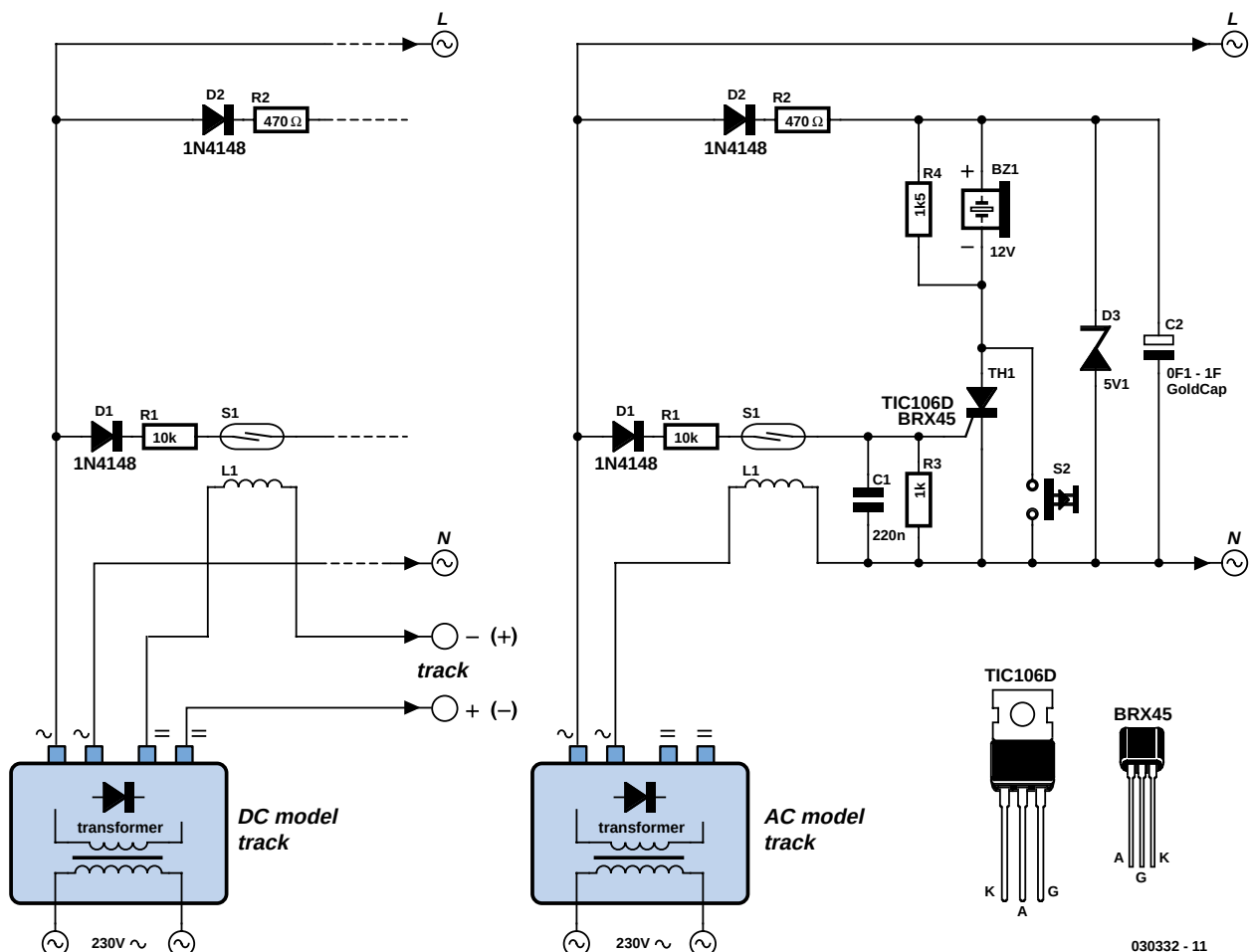
The rapid-acting acoustic short-circuit detector described here eliminates these problems. However, it requires its own power source, which is implemented here in the form of a GoldCap storage capacitor with a capacity of 0.1 to 1 F.

A commonly available reed switch (filled with an inert gas) is used for the current sensor, but in this case it is actuated by a

solenoid instead of a permanent magnet. An adequate coil is provided by several turns of 0.8–1 mm enamelled copper wire wound around a drill bit or yarn spool and then slipped over the glass tube of the reed switch. This technique generates only a negligible voltage drop. The actuation sensitivity of the switch (expressed in ampère-turns or A-t) determines the number of turns required for the coil. For instance, if you select a type rated at 20–40 A-t and assume a maximum allowable operating current of 6 A, seven turns ($40 \div 6 = 6.67$) will be sufficient. As a rule, the optimum number of windings must be determined empirically, due to a lack of specification data.

As you can see from the circuit diagram, the short-circuit detector is equally suitable for AC and DC railways. With Märklin transformers (HO and I), the track and lighting circuits can be sensed together, since both circuits are powered from a single secondary winding.

Coil L1 is located in the common ground lead ('O' terminal), so the piezoelectric buzzer will sound if a short circuit is present in either of the two circuits. The (positive) trigger voltage is taken from the lighting circuit (L) via D1 and series resistor R1. Even though the current flowing through winding L1 is an AC or pulsating DC current, which causes the contact reeds to vibrate in synchronisation with the mains frequency, the buzzer will be activated because a brief positive pulse is all that is required to trigger thyristor Th1. The thyristor takes its anode voltage from the GoldCap storage capacitor (C2), which is charged via C2 and R2. The alarm can be manually switched off using switch S1, since although the thyristor will return to the blocking state after C2 has been discharged if a short circuit is present the lighting circuit, this will not happen if there is a short circuit in the track circuit. C1 eliminates any noise pulses that may be generated.



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As a continuous tone does not attract as much attention as an intermittent beep, an intermittent piezoelectric generator is preferable. As almost no current flows during the intervals between beeps and the

hold current through the thyristor must be kept above 3 mA, a resistor with a value of 1.5–1.8 k Ω is connected in parallel with the buzzer. This may also be necessary with certain types of continuous-tone

buzzers if the operating current is less than 3 mA. The Zener diode must limit the operating voltage to 5.1 V, since the rated voltage of the GoldCap capacitor is 5.5 V.

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